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Statistical moments of soliton field in shallow water

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The ensemble of solitons plays an important role in the long-term dynamics of a wave field which can be interpreted as soliton turbulence. Dynamics of a soliton field in shallow water in the framework of Korteweg – de Vries equation is studied. The statistical ensemble is generated from the isolated solitons with random phases and amplitudes. Main interest is paid to the first four statistical moments (mean, variance, skewness and kurtosis) playing an important role in the turbulence theory. They are computed analytically for initial random soliton field presenting the linear superposition of the solitary pulses. It is demonstrated that the random soliton field is not Gaussian. Then the time evolution of the statistical moments is studied numerically. It is confirmed that first two moments being the invariants of the Korteweg – de Vries equation remain to be constant. The skewness and kurtosis vary in time in each realization but tends to the constants in the average. The averaged magnitude of these moments is decreased to compare with initial values with increase of the soliton density. This effect is related with features of the two-soliton interaction described in (E.N.Pelinovsky et al., Physics Letters A (2012) http://dx.doi.org/10.1016/j.physleta.2012.11.037). As a result, the nonlinear soliton interaction leads to tendency of normalization of the random process.
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